MALARIA

Malaria is a protozoal infection caused by "Plasmodium" and transmitted to man by bite of infected "female anopheline mosquito". Four species are known to infect man. These are *P vivax*, *P falciparum*, *P ovale*, *P malariae*; commonest is *P vivax*. Second commonest and severe one is *P falciparum*.

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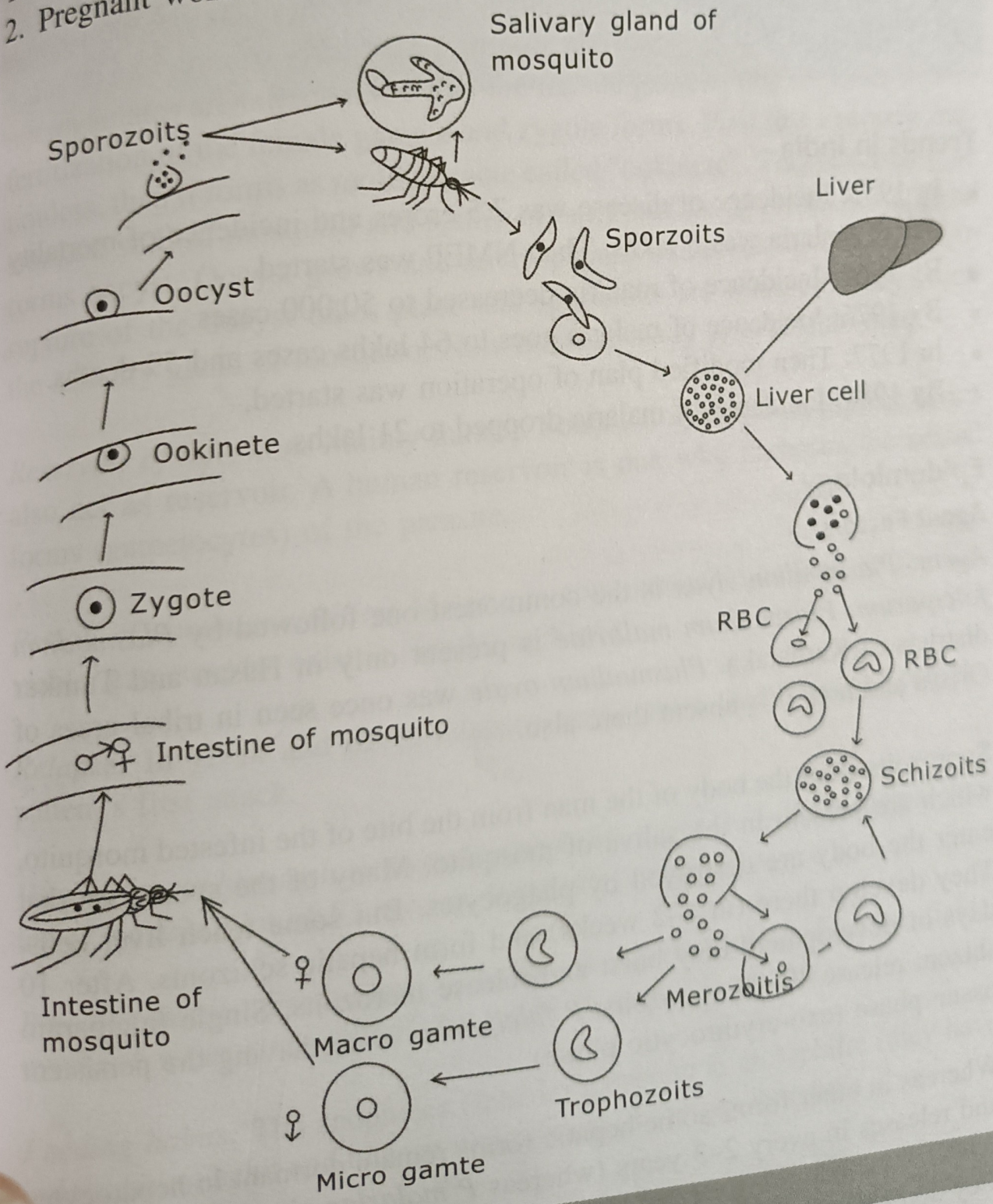
Geographical Distribution

It is a major public health problem in the world. 40% of world population (i.e., 240 crores) are exposed to malaria risk. 100 countries are suffering from this problem, where social and economial conditions are poor. Every year 30 to 50 crores cases are occuring in the world. In this, 90% cases are in Africa itself. Nearly 25 lakh deaths are occuring due to malaria per year. Individuals at higher risk of deaths are:

1. Children below 5 years age
2. Pregnant women



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3. People who visit endemic areas and come back. In association with anaemia and ARI it kills 10 lakhs children per year. Anaemia, the important complication of malaria, causes low birth weight children. 25% of LBW is due to malaria.

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Epidemiology

Agent Factors

Agent: Plasmodium vivax is the commonest one followed by *Plasmodium falciparum*. *Plasmodium malariae* is present only in Hasan and Tumkur districts of Karnataka. *Plasmodium ovale* was once seen in tribal areas of Orissa and now it is absent there also.

Sporozoits enter the body of the man from the bite of the infested mosquito, which are present in the saliva of mosquito. Many of the sporozoits that enter the body are destroyed by phagocytes. But some reach liver cells. They develop there (in 1–2 weeks) and form hepatic schizonts. After 10 days of development they burst and release merozoits. Single falciparum shizont release 40000 merozoits. *P falciparum* is not having the persistent tissue phase (exo-erythrocytic phase).

Whereas in other forms some hepatic forms remain dormant in hepatocytes and releases in every 2–3 years (whereas *P malariae* gives relapses 10–20 years). Here one thing we should remember that once parasites enter RBC they don't reinvade the liver.

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Erythrocytic cycle: This stage starts once merozoits are released from liver. They form schizoits in RBC, burst open and release merozoit. This stage is 48 hours for *P vivax*, *P falciparum*, *P ovale*. It is 72 hours in *P malariae*.

Gametogony: Some ring trophozoits do not form schizoit and they develop into male (micro) gametocytes.

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Life span: Ranges from 8–34 days (i.e., mosquito live maximum 34 days only).

Host Factors

1. *Age and sex*
   Common to all age groups except newborn infants. They are resistant to plasmodium because of high foetal haemoglobin content.
2. *Occupation*
   More in rural agricultural workers.
3. *Socio-economic status*
   Malaria is nearly eliminated in the developed countries. It is high in low socio-economic areas and countries.
4. *Sickle cell trait*
   Individuals with sickle cell trait are protected from *P falciparum*; even if get the infection the disease is mild. So Negro are resistant in *P falciparum* as most of them have sickle cell trait.
5. *Pregnancy*
   Pregnancy increases the risk and severity of malaria. Foetal complications are high. So using of antimalarials (chloroquine) in infected pregnant mothers is advised.
6. *Immunity*
   Repeated exposure for several years is necessary to get some amount of resistance. So in endemic malarious areas like African countries, a state of "collective immunity" slowly develops. So in African countries it is common to see persons with Plasmodium in their blood and without symptoms. Infants born to immune mothers are generally protected during 1st 5 months of life by maternal IgG antibodies.

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Mode of Transmission

1. **By vector**
   Infected, female, anopheles mosquito is responsible for spread of malaria. A single infected vector is able to spread infection to several persons.
2. **Direct transmission**
   "Through blood transfusion" is possible because the parasite is able to survive at 4°C up to 2 weeks.
3. Rarely, mother-to-child transmission will occur (congenital malaria). Thus infected mother can spread disease to child in womb.

Incubation Period

Incubation period is the time between bite of mosquito and appearance of symptoms (i.e., fever). It is usually 10 to 14 days (12 days for *P falciparum* and 14 days for *vivax*).

Clinical Features

In typical cases we can see three stages (cold stage, hot stage, sweating stage) followed by afebrile period; atypical cases are also common in endemic areas.

Cold stage (20–60 min): Nausea, vomiting, headache followed by rigors in one hour. Temperature goes up to 40°C. First skin is cold, later it becomes hot.

Hot stage (2–4 hours): During this stage patient has severe headache, full pulse and rapid respiration. Patient is burning hot.

Sweating stage (2–4 hours): Profuse sweating will occur during this phase and temperature comes to normal (even without giving antipyretics). Skin is cool and moist. Pulse rate comes to normal and patient feels relieved.

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Complications of P falciparum

- Cerebral malaria
- Acute renal failure
- Algid malaria (circulatory collapse)
- Anaemia
- Blackwater fever
- Hypoglycaemia
- Dehydration with fluid and electolyte disturbances and GIT symptoms.

Complications of *P ovale* and *P vivax*

1. Anaemia
2. Splenomegaly
3. Hepatomegaly
4. Herpes simplex (sometimes herpes zoster)
5. Renal complications.

Malariometry (i.e., measurement of malaria)

Malariometry is an essential component of Malaria Eradication Programme. It gives us clear idea about degree of endemicity, effectiveness of case detection etc.

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Prevention and Control of Malaria

Various incidents in malaria control programme are:

April 1953: National Malaria Control programme (NMCP) was launched. Cases were 75 millions. The NMCP was in action for 5 years.

By 1958: Cases were dropped to "two millions". Then NMEP (i.e., eradication programme) started.

- By 1961: Cases dropped further. It became 50,000 cases.
- By 1976: Because of some operational failure cases increased to 6.4 millions.
- In 1977: Modified plan of operation was started.
- By 1984: Cases dropped to 2.1 millions.

Some of the features of modified plan of operation are: In MPO the govt. utilised the "primary health care approach". This approach is based on integrated methods of disease control.

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Modified Plan of Operation (started in April 1977)

Objectives of MPO are:

- To prevent deaths due to malaria
- To reduce the morbidity (due to malaria)
- To maintain agricultural and industrial production by intensive antimalarial measures
- To consolidate the gains achieved (up to 1977).

Reclassification of Malaria Endemic Areas

The tool used for reclassification of endemic areas was API (annual parasite incidence):

- Areas with API two and more than two (≥2)
- Areas with API less than two (< 2)

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Malaria Vaccines (under trial)

1. Asexual blood stage vaccines: Based on antigens derived from the blood stages of *P. falciparum* present in man.
2. Second type of vaccine is designed to arrest the development of the parasite in mosquitoes.
3. A synthetic cocktail vaccine for *P falciparum* called "SPf 66" is under trial. This vaccine is formulated as a peptide alum combination. Trials show that it is a safe (and protective up to 30%) drug.
4. Transmission blocking vaccine: Like "PfS25", also under trial.

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Malaria programmes aim to control and eliminate malaria by detecting and treating cases early, and by reducing the breeding grounds for mosquitoes. These programs also involve the community to help identify and eliminate breeding grounds.

Malaria programs in India

National Vector Borne Disease Control Programme (NVBDCP)

This program integrates malaria control with other vector-borne disease control programs.

Enhanced Malaria Control Project (EMCP)

This project was launched in 1997 with support from the World Bank.

Intensified Malaria Control Project (IMCP)

This project was launched in 2005 with support from the Global Fund to fight AIDS, Tuberculosis and Malaria (GFATM).

National Strategic Plan for Malaria Elimination (2023-2027)

This plan was developed by the National Center for Vector Borne Disease Control (NCVBDC) to eliminate malaria in India by 2027.

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Urban Malaria Scheme (UMS)

This scheme provides grants to state governments to protect people from malaria and other mosquito-borne diseases.

Malaria programs globally

- **Global Malaria Programme (GMP)**: This program is coordinated by the World Health Organization (WHO) to control and eliminate malaria globally.
- **Malaria vaccine implementation program**: This program allocates doses of the first malaria vaccine to countries.
- **Gates Foundation**: This foundation invests in malaria eradication and prevention programs.

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